Examiner recognizes that Wu does not teach depositing the dielectric layer over the HSG by an ALD process. Thus, the Examiner explicitly relies on suggestion or motivation in the knowledge generally available to one of ordinary skill in the art (Office Action, page 9, lines 6-11, citing M.P.E.P. §706.02(j)).

As support for the proposition that suggestion or motivation is provided in the art, the Examiner states that Wu teaches a thin dielectric film and that one of skill in the art would be aware of the teachings of Suntola for depositing layers with good control of thickness. The Examiner summarily concludes, "there is enough motivation to combine the two references." Applicants submit that such a cursory treatment of this issue does no more than reassert that the prior art contains, in separate references, all of the features of the claims. The Examiner has provided no motivation or suggestion for the skilled artisan to make the asserted combination prior to the present invention.

Further, Applicants respectfully submit that the Examiner has focused on the two references and has not fairly considered "the knowledge generally available to one of ordinary skill in the art." As the Examiner points out, the teachings of Suntola had been known for over 20 years. Yet in all that time, there has been no teaching or suggestion that the method of Suntola is compatible with deposition of high-k materials on HSG silicon. To the contrary, there is a great deal of prior art that teaches that high-k materials, no matter how deposited, are incompatible with HSG silicon.

It has been generally understood in the art that ***high-k dielectric layers are not compatible with silicon bottom electrodes***. This is partly because the use of high-k materials involved either high-temperature deposition or high-temperature annealing, both of which could cause oxidation of the underlying silicon and thus decrease the overall capacitance. As stated in U.S. Patent No. 6,107,136 to Melnick et al., "high-k materials may be incompatible with many commonly used electrode materials because they require high temperature anneals in oxygen or deposition at high temperatures in the presence of oxygen in order to achieve their desired electrical properties." (column 1, lines 24-26).

In addition, any oxygen in the high-k dielectric material may react with silicon bottom electrodes to form oxide films with a low dielectric constant between the dielectric film and the bottom electrode. U.S. Patent No. 5,187,638 states that "one major hurdle to incorporating these materials into present day design is that they interact with polysilicon." (column 1, lines 45-47).

Consistent with the perception at the time of the invention that silicon and high-k materials were incompatible, U.S. Patent No. 6,037,206 teaches that there are three distinct ways to increase the capacitance in an integrated circuit: reduce the thickness of the dielectric layer, increase the interfacial area between the dielectric thin film and the electrode, and using a material with a high dielectric constant. (column 1, lines 35-53). There is no teaching or suggestion that these methods can be combined.

As a result of the incompatibility of polysilicon and high-k materials, it was well established in the art at the time of the invention that when high-k materials are used as the dielectric layer the bottom electrode is metal and not polysilicon. For example, U.S. Patent No. 6,037,206 indicates that to prevent problems associated with the deposition of dielectrics on polysilicon, "a metal layer, generally, is taken instead for the electrode, which is usually made of a polysilicon layer in the conventional method." (column 2, lines 4-6). Similarly, U.S. Patent No. 5,637,527 indicates that high-k materials may be used to increase the capacitance while minimizing the size of the capacitor but that "in using these dielectric films having a high dielectric constant, stable metal like platinum which is non-reactive is ***required*** to maintain characteristics of low leakage current." (column 1, lines 27-20; emphasis added).

The Examiner has provided no specific teaching or suggestion in the prior art to use ALD to deposit high-k materials on polysilicon. The general state of the art, as discussed above, teaches away from depositing a high-k dielectric layer on polysilicon and would ***not*** have led one of general skill to combine the teachings of Wu and Suntola. As a result, the Examiner has failed to make out a *prima facie* case of obviousness.

The skilled artisan would not have expected to succeed

Not only does the Examiner need to show a specific suggestion, from the prior art, to conduct the asserted combinations, but the Examiner also needs to show that the skilled artisan would have expected such a combination to succeed. "Both the suggestion [to combine] and the ***expectation of success***, must be founded in the prior art, not in the applicant's disclosure." *In re* Dow Chemical Co., 5 U.S.P.Q.2d 1529, 1530 (Fed. Cir. 1988) (emphasis added). Even if sufficient suggestion existed to conduct the combination, Applicants submit that the skilled artisan, at the time of the invention, would not have expected success.

Applicants had previously argued that the skilled artisan would not have expected success in combining Wu with Suntola et al. due to the expectation that HSG silicon would be unstable adjacent a high dielectric material. In response, the Examiner points out that Wu taught that it was possible to have "a high dielectric film such as tantalum oxide." Final Office Action at p. 10 (*quoting* Wu, Col. 7, lines 14-20).

Applicants concede that this teaching would be sufficient if the rejections involved anticipation. However, the present rejections do not merely recite a high k dielectric over HSG silicon, but rather involve the ***obviousness*** of using ALD to form a high k dielectric over HSG silicon. In this case, the Examiner must consider the entire field in determining whether the skilled artisan would have been motivated to make the asserted combination.

The rejections employ an isolated statement in Wu, which is directed to the formation of HSG silicon, to the effect that the dielectric can comprise one of a number of materials and mentions one high k dielectric material in passing. Wu does not mention or consider the relative advantages and disadvantages of using high k materials in combination with HSG silicon, to say nothing of providing processes to enable the use of high k materials while overcoming the known disadvantages of such a combination.

The Examiner cannot merely look to the isolated statements of Wu without also determining how these might be interpreted by the skilled artisan, and without also looking to the remainder of the field of interest to determine whether the combination is fairly suggested.

> In determining whether such a suggestion can fairly be gleaned from the prior art, ***the full field of the invention must be considered*** for the person of ordinary skill is charged with knowledge of the entire body of technological literature, including that which might ***lead away*** from the claimed invention.

In re Dow Chemical Co., 5 U.S.P.Q.2d at 1531-32 (emphasis added). Additionally, the Examiner must consider any evidence that the prior art indicated a lack of expected success. *Id.* at 1530.

Applicants submit that as discussed above, the art as a whole would have considered high k materials over HSG silicon to be impractical, despite the teachings of Wu, and there is no evidence that the skilled artisan would have conducted the combination with ALD asserted by the Examiner.

In making any combination of Wu with other teachings, the teachings of Wu (particularly the use of high k materials over silicon) must be weighed against a wealth of references in the art that counsel against using a high k material over silicon, **including U.S. Patent Nos. 6,037,206; 5,187,638; 5,869,860; 6,184,074, 5,637,527 and the other patents submitted with the**

accompanying Information Disclosure Statement. Note that the perceived disadvantages of high-k materials over silicon electrodes at the time of the invention were not merely of a nature to make their use undesirable; rather the disadvantages are such as to make their use completely impractical.

As the Examiner has not provided any specific suggestion or teaching from the prior art to combine Wu and Suntola, and because one of ordinary skill in the art would not have expected such a combination to succeed, Applicants submit that the present rejections under §103 should be withdrawn.

CONCLUSION

In view of the foregoing remarks, Applicants request reconsideration of the final rejections and respectfully submit that the claims are in condition for allowance. If, however, some issue remains that the Examiner feels can be addressed by Examiner's Amendment, the Examiner is cordially invited to call the undersigned for authorization.

Respectfully submitted,

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